**JOINT MPH PROGRAM**

**Addis Continental Institute of Public Health**

**and**

**University of Gondar**

# COST ASSESMENT OF ANTIRETROVIRAL THERAPY IN ZEWDITU HOSPITAL

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**Abbreviations**

3TC: Lamivudine

ART: Antiretroviral therapy

ARV: Antiretroviral

CD4: Cluster of Differentiation

D4T: Stavudine

DMIS: Drug Management Information System

EFV: Efavirenz

GFATM: Global Fund for AIDS, Tuberculosis and Malaria

HAART: Highly Active Antiretroviral therapy

HIV/AIDS: Human Immune Deficiency Virus/Acquired Immune Deficiency Syndrome

HMIS: Health Management Information System

NVP: Nevirapine

OI: Opportunistic Infection

PEPFAR: President's Emergency Plan for AIDS Relief

PLWHA: People Living With HIV/AIDS

PPY: Per person year

TB: Tuberculosis

US/A: United States of America

USD: United States Dollar

WHO: World Health Organization

ZDV: Zidovudine

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**Abstract**

**Background**

Little information is known on the annual cost of ART in Ethiopia despite an increase in scale up of ART in Ethiopia.

**Methods**

We examined data from 188 patient records that were on ART for one year at Zewditu Hospital. Data on cost and utilization of ART were taken and analyzed from Zewditu Hospital perspective. Final direct treatment cost, human resource, overhead and capital cost were identified and internal cost comparison was done.

**Result**

The mean per person year total cost of treatment at out patient level was USD 342.6 including USD314 in direct treatment cost, USD19 in direct health professional cost, USD 5 in over head and the final USD 3.03 goes to ART related capital cost. The direct treatment cost takes a staggering 91% of the total cost. Provision of ARV takes the highest cost of USD 210.82 followed by ART monitoring lab tests of USD90.

**Conclusion**

PPY cost of ART in a public sector health facility in Ethiopia is USD342.6 with ARVs taking the largest cost share of ART cost of 62%. Further calculations revealed a total of 1 physician, 2.5 nurses, 4.5 lab technicians and 1 pharmacist are needed to treat 1000 ART clients in a public health facility.

## 1. Introduction

In 2007 there were 2.7 million new HIV infections and 2 million HIV-related deaths. The rate of new HIV infections has fallen in several countries, but globally these favorable trends are at least partially offset by increases in new infections in other countries. In 14 of 17 African countries with adequate survey data, the percentage of young pregnant women (ages 15–24) who are living with HIV has declined since 2000-2001. In 7 countries, the drop in infections has equaled or exceeded the 25% target decline for 2010 set out in the *Declaration of Commitment* (1, 3).

As treatment access has increased over the last ten years the annual number of AIDS deaths has fallen. Sub-Saharan Africa remains the region most heavily affected by HIV, accounting for 67% of all people living with HIV and for 75% of AIDS deaths in 2007. However, some of the most worrisome increases in new infections are now occurring in populous countries in other regions, such as Indonesia, the Russian Federation, and various high-income countries. Globally, the percentage of women among people living with HIV has remained stable (at 50%) for several years, although women's share of infections is increasing in several countries. In virtually all regions outside sub-Saharan Africa, HIV disproportionately affects injecting drug users, men who have sex with men, and sex workers (1)

Ethiopia is currently one of the countries most seriously affected by HIV/AIDS, with the sixth highest number of infections in the world. To combat this epidemic, the government of Ethiopia has launched a national HIV/AIDS program focused on decreasing the vulnerability of individuals and communities to the disease, providing care and support

for people living with HIV/AIDS, and reducing the adverse socioeconomic consequences of the epidemic(2).

Many African countries are rapidly expanding HIV/AIDS treatment programs. Empirical information on the cost of delivering antiretroviral therapy (ART) for HIV/AIDS is needed for program planning and budgeting as the existing research on HIV/AIDS focus on the prevalence and natural history than cost(2,3).

However, annual expenditure on HIV/AIDS interventions in resource poor countries have increased 30 times over the last ten years to an estimated 10 billion in the 2007(3).

WHO recommends that in ARV treatment programmes in resource-limited settings HIV infected adolescents and adults should start ARV therapy when they have clinical AIDS, regardless of CD4 count. When total lymphocyte count can be assessed, in addition people with WHO stage II or III HIV disease should be offered treatment. When CD4 counts are available, all HIV infected people with less than 200 CD4 cells/mm3 should be offered treatment (2).

WHO, also recommends that in resource-limited settings a single first-line regimen should be identified for the treatment of the majority of new patients. This regimen would consist of 2 nucleoside analogs and either a non-nucleoside or abacavir, or a protease inhibitor. Zidovudine (ZDV)/3TC are the initial recommendation for a dual nucleoside analog with d4T/3TC, ZDV/ddI and ddI/3TC as possible alternatives. Efavirenz and nevirapine are recommended non-nucleosides, while recommended protease inhibitors include ritonavir-boosted PIs (indinavir, lopinavir, saquinavir) or nelfinavir. A second line regimen should be chosen to substitute first line regimens when needed (for toxicity or treatment failure)(9).

Clinical assessment prior to the initiation of ART includes documentation of past medical history, identification of current and past HIV related illnesses, identification of co-existing medical conditions and medications in use that may influence choice of therapy (such as TB or pregnancy) as well as current symptoms and physical signs.

Minimum laboratory tests include an HIV antibody test, and (if ZDV is part of the regimen) haemoglobin or hematocrit level. Highly desirable tests are white blood cell count and differential, CD4 count, serum alanine, aspartate aminotransferase level, serum creatinine, blood urea nitrogen, serum glucose, bilirubin, amylase and serum lipids, and pregnancy tests for women(6).

Last, there needs to be a reliable source of financing of the services and medicines provided. In many settings there are already some people who can provide quality services, there is already some infrastructure that can be used, and there are already some people who can pay for the service they need. In these settings treatment should be offered now, while resources are sought and the health service is strengthened to do more in the future. Today, with the increased availability of funds through the Global Fund, PEPFAR, the World Bank and other donors, there is a considerable window of opportunity for developing countries to scale up access to antiretroviral therapy. (3)

In order to realize universal access to free ART by 2009/2010, the Federal Ministry of Health (MOH) is committed to decentralize further the expansion and integration of HIV/AIDS prevention and control activities with primary health care services at grassroots where the majority of the population lives (5).

As HIV treatment is for life, it is critical that treatment programmes be sustained for the long term. Among the developments needed to ensure the continuity of HIV treatment are

more affordable second- and third-line therapies, as well as greater success in preventing new HIV infections.

Often cost analyses are an integral component of program implementations. Cost and cost-effectiveness analyses serve to provide basic evidence for on-going policy questions and debates. Cost analyses have always been identified with issues of efficiency, cost recovery and sustainability of programmes. However, cost analysis can also play an important role in examining issues of equity and targeting, which have recently come to the forefront of the policy debate (11, 12, 13, 14, and 15).

Cost data are necessary prerequisite to evaluate cost effectiveness of HIV treatment in this severely cost-constrained setting which account for the greatest share of the global burden of HIV disease (5).

The aim of this study was, to estimate the financial and human resource cost of providing highly active antiretroviral therapy (HAART) in a public health facility in Addis Ababa for the first year of treatment(6)

## 2. Literature review

Antiretroviral therapy (ART) is extremely effective in resource poor setting increasing survival for patients with AIDS from 30% to 90% at one year (7-10).However In Ethiopia and the remaining African Countries there are no much published studies on ART cost analysis based on existing programs examining the different approach for the treatment and prevention of HIV/AIDS(5)

However a number of excel spread sheet and life time cost models have been developed and estimated the life time cost of delivering ART. Ethiopia is one of the big recipients of GFTAM and PEPFAR support but there are still significant proportions of PLWHA demanding ART (3, 7).

When compared to most African countries relatively South Africa has got quite a good experience in doing costing and cost-effectiveness analysis for HIV/AIDS interventions. Recently WHO published a new and staggering topic called Universal testing and immediate treatment could cut HIV infections by 95% in 10 years. The WHO model used South Africa as an example, taking data on infection rates and disease progression to model the effects of expanding knowledge of HIV status and a growing uptake of antiretroviral treatment. The model assumed that with a baseline HIV prevalence of 16%, a 99% decline in infectiousness when individuals started treatment, and 90% coverage of treatment in the HIV-infected population by 2016, 104,000 deaths would be averted in 2015 alone when compared to starting treatment at a CD4 cell count of 350 cells/mm3 (in itself an optimistic threshold)(16)

The model assumed an annual treatment cost (including drugs, monitoring and patient management) of $727 a year for first-line treatment and $3290 for second-line treatment, with antiretroviral drugs accounting for 30% of the cost.

The model showed that HIV transmission would decline very steeply as HIV treatment coverage expanded, falling from around 15 new infections per thousand adult and adolescent inhabitants today to 1 per thousand by 2016.

Although the universal treatment strategy would cost three times more than treating everyone with a CD4 cell count below 350 cells/mm3 in 2015 ($3.4 billion a year), the yearly cost would begin to fall after this point, and by 2030 the approach would become less expensive than treating only those with CD4 counts below 350 cells/mm3 (approximately $1.8 billion) (14).

USA experience: Health care expenditures for persons infected with human immunodeficiency virus (HIV) in the United State determined on the basis of actual health care use have not been reported in the era of highly active antiretroviral therapy. Patients receiving primary care at the University of Alabama at Birmingham HIV clinic were included in the study. All encounters (except emergency room visits) that occurred within the University of Alabama at Birmingham Hospital System from 1 March 2000 to 1 March 2001 were analyzed. Medication expenditures were determined on the basis of 2001 average wholesale price. Hospitalization expenditures were determined on the basis of 2001 Medicare diagnostic related group reimbursement rates(12).

Clinic expenditures were determined on the basis of 2001 Medicare current procedural terminology reimbursement rates. Among the 635 patients, total annual expenditures for

patients with CD4+ cell counts <50 cells/μL ($36,533 per patient) were 2.6 times greater than total annual expenditures for patients with CD4+ cell counts ≥350 cells/μL ($13,885 per patient), primarily because of increased expenditures for non-antiretroviral medication and hospitalization. Expenditures for highly active antiretroviral therapy were relatively constant at ~$10,500 per patient per year across CD4+ cell count strata. Outpatient expenditures were $1558 per patient per year; however, the clinic and physician component of these expenditures represented only $359 per patient per year, or 2% of annual expenses. Health care expenditures for patients with HIV infection increased substantially for those with more-advanced disease and were driven predominantly by medication costs (which accounted for 71%–84% of annual expenses). Physician reimbursements, even with 100% billing and collections, are inadequate to support the activities of most clinics providing HIV care. These findings have important implications for the continued support of HIV treatment programs in the United States(12).

This team sought to project the lifetime cost of medical care for human immunodeficiency virus (HIV)-infected adults using current antiretroviral therapy (ART) standards. Medical visits and hospitalizations for any reason were from the HIV Research Network, a consortium of high-volume HIV primary care sites. HIV treatment drug regimen efficacies were from clinical guidelines and published sources; data on other drugs used were not available. In a computer simulation model, we projected HIV medical care costs in 2004 U.S. dollars. From the time of entering HIV care, per person projected life expectancy is 24.2 years, discounted lifetime cost is $385,200, and undiscounted cost is $618,900 for adults who initiate ART with CD4 cell count <350/μL. Seventy-three percent of the cost is antiretroviral medications, 13% inpatient care, 9%

outpatient care, and 5% other HIV-related medications and laboratory costs. For patients who initiate ART with CD4 cell count <200/μL, projected life expectancy is 22.5 years, discounted lifetime cost is $354,100 and undiscounted cost is $567,000. Results are sensitive to drug manufacturers' discounts, ART efficacy, and use of enfuvirtide for salvage. If costs are discounted to the time of infection, the discounted lifetime cost is $303,100. Effective ART regimens have substantially improved survival and have increased the lifetime cost of HIV-related medical care in the U.S.(5)

Zambian Experience: The Zambia study analyzes the costs and resource requirements associated with the provision of ART, VCT, several opportunistic infections and PMTCT services. These per patient cost estimates used to project total program costs, which are then compared to currently budgeted resources with an emphasis on financial sustainability. The report also explores a range of policy issues including the importance of human resource constraints; the implications of alternative monitoring protocols and drug regimens; opportunities for resource mobilization and targeting issues. Over all the study emphasizes ART costs rather than to propose any definitive answers (13).

Haiti Experience: the Haiti study determined direct medical costs, overhead costs, and societal costs and personnel requirements for the provision of ART to patients with AIDS.Data from 218 treatment naive adults were examined (20).

## 3. Objective:

- To provide a comprehensive analysis of the costs and resource requirements for the provision of ART in a public sector health facility.

### 3.1 Specific Objectives:

-To determine the incremental costs (direct medical costs, overhead costs, capital cost and personnel cost) of providing ART at a public health facility from the health facility perspective.

-To determine the initial annual per person year cost of providing ART service at zewditu Hospital

- To compare cost components of antiretroviral therapy in a public health facility

## 4. Methodology-

**4.1 Design-** The design was a cross-sectional record review study of treatment naïve patients, who initiated ART at Zewditu between August, 2006-November, 2006. It involves collection of service utilization data from patient medical records, ART personnel, capital and overhead resources consumed and converting in to PPY year cost. Also involves secondary data analysis of HIV/AIDS commodities and program cost from reputable sources available locally or internationally.

**4.2 The study area:**

The study was conducted at zewditu Hospital. Zewditu is one of the oldest public health facilities in Addis Ababa under Kirkos subcity. It provides patient care and opportunistic infection treatment; PMTCT services, provider initiated counseling and testing for TB, follow up complicated case of TB and transfer of patients to health center for DOTS and initiate antiretroviral therapy as per the national standard. Free ART program has started in March 2005 and since September 2005 the hospital transferred more than 1800 patients to health centers under Akaki Kaliti and Kirkos sub cities. This hospital started the first free ART in the country in January 2005 and currently has more than 7500 active patients on treatment. The hospital has almost the same number of clients on chronic care. The facility also initiates ART on at least 5 new treatment naïve patients every day. Currently the ART unit has 2 medical doctors, 3 advanced ART nurses, 5 staff nurses, 3 data clerks, 1 pharmacist, 2 druggists, 1 lab technician, six case mangers, 5 adherence supporters and a pediatric ART physician with two nurses(9).

Patient selection and the ART regimen at Zewditu followed national recommendations and those set by WHO guide lines. Treatment is provided on out patient basis and with a rare admission for critically ill patients. Referral is done in few occasions for dental and blood transfusion.

All patients presented to ZH receive HIV Voluntary counseling and testing and screening for other sexually transmitted diseases. All patients with cough under go evaluation for TB. HIV positive patients have a history and physical examination by a physician and a base line CD4 is measured. Patients with AIDS defining illness or a CD4 count less than 200 cells/ml are started on ART. Prior to starting ART, a complete blood count, renal function tests and liver enzyme test are preformed and patients meet with nurse/social worker for ART counseling and education.

In the hospital ART treatment protocol patients on ART are to be seen in the clinic weekly for the first two month of therapy and then monthly there after. At each visit patients are seen by a clinician (physician or nurse) and by a pharmacist who dispense ARV and provides adherence counseling.

Laboratory monitoring includes CD4 counts, liver function tests, renal and glucose tests and complete blood counts. If an opportunistic infection is suspected, appropriate laboratory testing is performed. TB medication are prescribed in the ART clinic and dispensed in the TB clinic setting.

**4.3 Sample Size-**

The purpose of the study is to estimate the mean initial annual cost of ART at Zewditu Hospital.

$$\text{Sample size (n)} = z^2 sd^2 / w^2$$

Where Z =1.96 at 95% CI

SD= standard deviation

In a cost study made in Arbaminch hospital they estimated the service use and mean annual cost of care from 58 patients on ART. Using this sample size they obtained mean annual cost of US$ 235.44(218.11-252.78). The following calculation is done to get the standard deviation.

So that 34/2=1.96 s/square root of n. 34/2=1.96*S/7.5

17*7.5=1.96*S

S=130/1.96=64

D=9.1(assumed to be the marginal error, equivalent to 1 USD at the September, 2006) the sample size for this study was $N=Z^2S^2/d^2=1.96^264^2/9.1^2$

$= 3.84*4096/83=188$

**4.4 Sampling**: Out of the 5000 clients on ART at Zewditu Hospital only those previously treatment naïve clients started ART at Zewditu Hospital in the last one and half year was considered for this protocol. Patients lost to follow-up and pediatric clients less than 12 years will be excluded from the research.188 patients were selected based on convenience to ensure that each patient is treatment naïve when he/she started treatment

### 4.5 Inclusion Criteria:

Medical records of All adult ART clients greater than 12 years who were treatment naïve during ART initiation and currently active were eligible for the research. The patients should at least continued taking ART services at this Hospital for a year.

### 4.6 Exclusion Criteria:

Patients transferred from other facilities to Zewditu after previously taking ART at any other health facility were not considered. Also patients that didn’t complete or lost to follow-up before the first year treatment are excluded. Pediatric clients less than 12 years and adult clients lost follow-up with less than a year on treatment are excluded.

**4.7 Data collection-**

**4.7.1 Cost data.**

Costing was done from Zewditu Hospital perspective and included out patient costs using a bottom up approach in which each component of health care that is consumed is recoded and multiplied by a unit cost. Using a bottom-up costing [6] approach, individual cost components were identified, estimated and/or calculated on a per-patient basis as accurately as possible. These costs were then aggregated, yielding a total per-patient year cost.

Actual health care services utilization was determined from consecutively enrolled treatment naïve adult AIDS patients who initiated ART at Zewditu hospital from September 1, 2006-November 30, 2006. For each patient age, weight, WHO clinical stage, OI illnesses, laboratory and radiographic tests conducted, ARV medications and number of pills dispensed, medications for OI,TB were collected and entered in to EPI info.

Service utilization and costs were estimated for direct out patient ART service utilization, direct health labor, direct capital (building and equipment) and recurrent inputs for final HIV care and treatment services; other shares from the hospital overhead costs were also included as an ingredient to the total cost.

Direct health services include consultations at the HIV clinic, laboratory tests, imaging, and drug dispensing.

Due to the unavailability of capital cost estimation, the economic cost of building based on the market renting price was used for the building and the replacement cost for the medical equipments.

A combination of data collection tools were used for the collection of quantitative data. This included a data collection tool from the medical records (annex2) and an ART costing based on the cost of products when they are availed in Ethiopia. A tool for collecting data from the patient medical records is developed and available in the annex part. Using this tool we extracted weight, diagnosis, laboratory and radiographic tests conducted and other investigations, ART medications and number of pills dispensed, medications for TB, and Opportunistic infections, referral to higher level care and hospitalization.

Through out this study costs were measured in 2006 US dollar, 1 USD= 9.1 ETB(18),the cost of ARVs,OI drugs , other medications and lab reagents were obtained from the national quantification report. Costs for TB drugs were obtained from the WHO cost for full DOTS for six months.

The cost of laboratory tests that were not available on the national quantification was obtained internally from Zewditu Hospital accounting.

To determine labor cost in the ART clinic an time motion observational study and an interview was conducted on the average time needed to consult and diagnose a patient. The pharmacist was interviewed on the estimate of time needed to dispense ARVs and OI drugs to the client. To reduce observation bias measurements were conducted from the waiting room at unannounced dates and times. To determine the lab personnel labor we used the estimation of the lab technician for the time the machines take to give results. A fair estimate for sample taking and patient preparation was included in to the time taken by the machine to run multiple tests at a time.

To estimate this indirect labor cost it is assumed that for every direct minute of health professional 50%, i.e. 30 seconds for each health professional minute. Indirect labor cost for the administrative staffs is assumed as 50% of the face to face time spent.

**4.8 Data Analysis:**

Patient related data were entered to epiInfo and then exported to SPSS for analysis. The primary outcome was base line characteristics. Service utilizations were presented as mean and median with mean cost (see Tables 1 and 2). For primary outcomes, univariate analyses were conducted using the following variables: Base line CD4 cell count, age, sex. WHO clinical stage, ARV regimen, and baseline weight.

The final expected out come of this study was cost of management for one year. Direct cost was approximated by the use of out patient based ART care services presented as mean and median costs with inter quartile ranges.

Secondary out comes included physician, pharmacist, nurse, lab technician and counselor time. Overhead and capital costs were calculated from the facility records.

**4.9 Data Quality**

Data were collected by the head nurse of the ART clinic from the patient records and closely supervised by the PI .Data entry; cleaning and analysis were done exclusively by the PI with technical support of ACIPH statisticians. Measures were taken when there are occasions that could affect the data quality.

### 4.10 Ethical consideration

Ethical clearance was obtained from the ACIPH/UoG ethical committee and informed consent was obtained from Zewditu Hospital staffs that were observed. The data collection tool doesn't require the name of the patient. All information is collected from the patient folder using folder number.

### 4.11 Operational definitions

#### 4.11.1 Direct cost of ART

Direct cost of ART is the total value of the resources expended by Zewditu Hospital in delivering ART to the patient directly. This study's direct cost identified in terms of direct service utilization (lab, ARVs, OIs, other medications and professionals directly involved)

#### 4.11.2 Over head costs

Overhead are costs which are used by the ART clinic and shared by other services too.

#### 4.11.3 Capital costs

Capital costs are the cost of building and equipments or machines consumed/used by the ART clinic.

## 5. Results

### 5.1 Base line characteristics of patients sampled for Costing record review (n=188)

The details of various baseline characteristics of the patients are summarized in table 1.The records reviewed consists of 188 treatment naïve patients initiated ART at Zewditu Hospital between September-November,2006.

**Table 1: Base line characteristics of patients sampled for Costing record review**

| Characteristics | | Number | Percent |
|---|---|---|---|
| Sex | Male | 79 | 42 |
| | Female | 109 | 58 |
| Age | 12-20 year | 2 | 1.1 |
| | 21-30 year | 77 | 41.4 |
| | 31-40 year | 60 | 32.3 |
| | 41- 50 year | 34 | 18.3 |
| | > 50 year | 13 | 7.0 |
| Initial ART regimen | ZDV/3TC/NVP | 62 | 29.87 |
| | D4T/3TC/NVP | 66 | 31.73 |
| | ZDV/3TC/EFV | 38 | 18.27 |
| | D4T/3TC/EFV | 36 | 17.30 |
| | Other Regimens | 6 | 2.83 |
| Baseline CD4 | <50 | 25 | 14.4 |
| | 50-199 | 120 | 69 |
| | >199 | 29 | 16.7 |
| WHO clinical stage | Stage I | 2 | 1.1 |
| | Stage II | 37 | 19.7 |
| | Stage III | 91 | 48.4 |
| | Stage IV | 57 | 30.3 |

Female treatment recipients constitute 58% of the total clients now on treatment are more frequent than the male.

Age range of 21-40 constitute almost 3/4$^{th}$ of the total clients on treatment where as 2 and 13 patients were recorded as under 20 and over 50 respectively.

All the four first line regimens were observed with small percentage going to non first line regimens in the first year of treatment. Nevirapine based regimen constitute almost 65% of the total patients on treatment which is in line with the national guide line (16).Few regimens containing Tenofovir are reported from Zewditu Hospital. The total regime was greater than the total patients sampled because of shift within the guide line (5). Regimen shift to new drugs were also observed in 2.83% of patients on treatment which results due to adverse drug reaction and failure to improve after initiation (5)
Most patients analyzed fall to the 51-199 CD4 counts which fairly supports the national assumption. 14 patients initiated ART with out base line CD4 either due to machine failure or stock out of test kits.

The Stage three constitute almost 50% of the total clients on ART while stage one is the list. Patients with CD4 count more than 200 were put on treatment due to clinical progression of disease showing specific stage IV illnesses. In the health facility staging is done based on either cd4 count or clinical symptoms that show disease progression.

### 5.2 Direct Treatment Utilization and cost for the total records reviewed

For the successful use of ARVs there should be access to specific services and facilities: HIV counseling and testing and follow-up counseling services to ensure psychosocial support and adherence to treatment; Capacity to appropriately manage HIV related illness and opportunistic infections; A laboratory that provides tests for monitoring treatment; A continuous supply of antiretroviral and medicines for the treatment of opportunistic infections and other HIV related illnesses; In addition, there is a need for adequately trained doctors, clinical officers, nurses, laboratory technicians, pharmacists, counselors and clerks to provide the services required.

The actual health care services utilization for the first year of treatment was determined from 188 consecutively enrolled treatment naïve patients at Zewditu Hospital from September 1, 2006 to November 30, 2006. Costs were determined from Zewditu hospital perspective and included all costs for pre-ART and the next 12 months after ART initiation. The unit cost per test for lab include cost for reagent, consumables like syringes, pipettes, gloves, specimen slides, lancets and running cost added based on an expert opinion. Together these yielded the total unit cost for materials per test. Estimation of lab building cost for Zewditu is a difficult task as the building is serving beyond its estimated age and no clue about initial cost. Calculating the economic cost per square meter based on the market price has been the best alternative and this was treated with other capital items in table 5.

The unit cost for ARV and OI drugs per patient include the cost plus 10% for domestic clearance, storage and distribution. The original cost is taken from the national HIV/AIDS commodities quantification report (25).

Cost for xray is taken from Zewditu hospital a client paying for a single chest xray the same applies for AFB.

**Table 2: Direct treatment utilization and costs for the total records reviewed (n=188)**

| | Mean utilization per patient for the 1st year of ART | Median utilization (IQ range) per patient for the year of ART | Mean cost per patient for the 1st year of ART (USD) |
|---|---|---|---|
| Clinical chemistry( mean # of tests) | 4.55 | 5 ( 3 to 6) | 34.94 |
| CD4 cell count (mean # of tests) | 2.09 | 2 (2 to 2) | 20.27 |
| Hematology( mean # of tests) | 4.88 | 5 (4 to 6) | 32 |
| TB tests/AFB (mean # of tests) | 1.16 | 1 (1 to 1) | 1.16 |
| HCG(mean # of tests) | 1.07 | 1 (1 to 1) | 1.07 |
| Stool (mean # of tests) | 1.51 | 1 ( 1 to 2) | .5 |
| Other laboratory tests(mean # of tests) | 1.09 | 1 (1 to 1) | 1 |
| **Total Lab and imaging** | | | **90.94** |
| Chest radiographs ( mean # of x-rays) | 1.21 | 1(1 to 1) | 1.78 |
| D4T/3TC/NVP(mean # number of tablets) | 689.11 | 720 (720 to 720) | 29.20 |
| D4T/3TC/EFV(mean # of tablets) | 684.61 | 720 (720 to 720) | 37.50 |
| ZDV/3TC/NVP( mean # of tablets) | 661.96 | 720 (720 to 720) | 80.82 |
| ZDV/3TC/EFV(mean # of tablets) | 684.61 | 720 (720 to 720) | 52.86 |
| Other regimens( mean # of tablets) | 720 | 720(720 to 720) | 10.44 |
| **Total Antiretroviral Drugs** | | | **210.82** |

| | | | |
|---|---|---|---|
| TB medication (mean # number of days on therapy) | 42 | 0(0 to 0) | 2.57 |
| Cotrimoxazole( mean # of tablets) | 362.98 | 360(360 to 360) | 7.50 |
| FANSIDAR( mean # if tablets) | 3.7 | 0(0 to 0) | 0.3 |
| ACYCLOVIR(mean # of tablets) | 4.90 | 0(0 to 0) | 0.1 |
| Dactrin Oral Jel( mean # of tablets) | 0.3 | 0(0 to 0) | 1 |
| Fluconazole(mean # of tablets) | 18 | 0(0 to 0) | 0.7 |
| Other medications( mean # of tablets) | 28.81 | 0(0 to 0) | 0.5 |
| **Total TB,OI and other medications** | | | **12.67** |

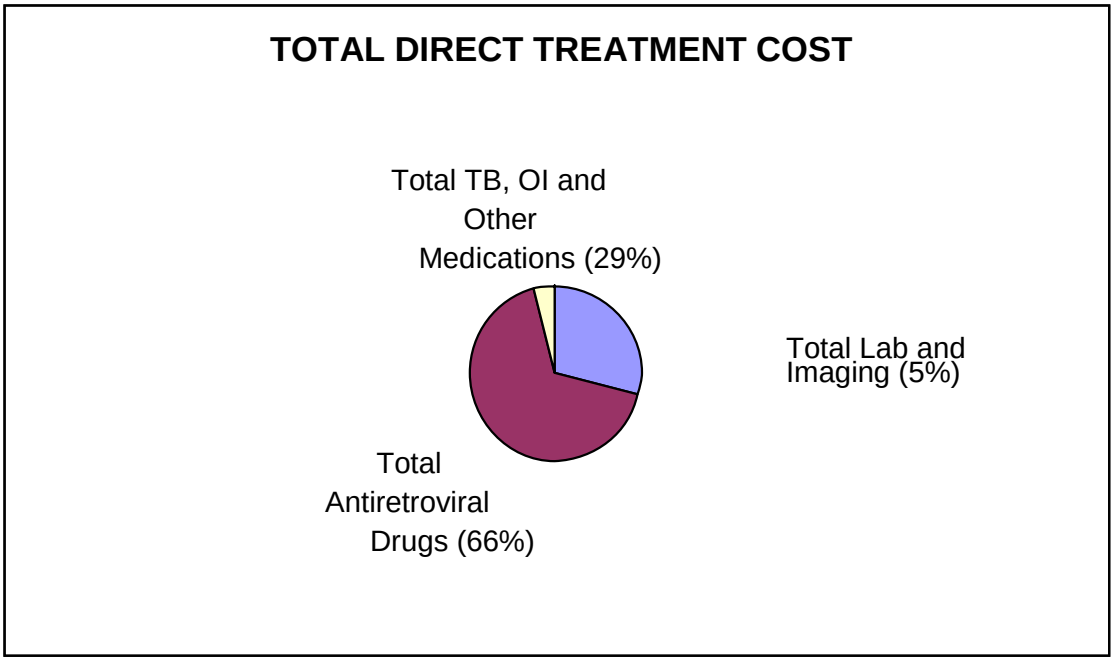


Fig 2: Total PPY Direct treatment cost.

This figure indicates the major cost proportions with antiretroviral drugs constituting 66% antiretroviral drugs. Lab and imaging come second while other non-ARV drugs take little proportion.

**5.3 Direct Health Professional Cost**

From observation conducted it is found that on average a physician spend 10minutes and nurses spend 20 minutes per single visit. For an MD level work which is diagnosis and consultation an average number of minutes spent per patient during baseline, ART initiation and monitoring and ART continuation phase visits for one year were converted in to weighted salary per minute. This weighted salary per minute on clinical activity per patient was used to convert the minutes in to birr and then dollars. These values then used to calculate the final cost on clinical activity the same was applied for lab and pharmacy. For out patient care ,number of visits is the unit of out put, this total out put must be divided by the total inputs(time) to get the unit cost of per visit(15).A time motion observation approach was followed for ART clinic, pharmacy and lab.

It should be noted here that public sector health workers have on average the following days of leave each year: 35 days vacation; 20 days for sickness; 13 public holidays; and 12 days for mother's leave (females only). Based on 260 week days/year, the average number of days worked each year by one worker is 180. It is assumed that in each eight-hour day, a worker is actively providing client service for six hours and that two hours are for other work, such as staff meetings, logistics management, or waiting time(6).

As the ART clinic, lab and pharmacy are organized for the unit separately from other services all professional staffs spend 100% of their time serving ART and pre ART clients at the clinic. Based on the monthly salary for the various staffs and assuming 1600 working hours per year and the total time worked per month come up with the weighted

salary per minute. So the mean total physician time 1.67 hours per patient per year and 4 nurse hours per patient per year. By the same token it takes 7.16 lab technician hours and 1 pharmacy technician hours per patient per year. It is assumed that each full time professional will work 1600 hours per year.

**Table 3: Labor cost to the ART clinic, lab and pharmacy personnel**

| | Average number of Minutes per visit | Total number of visits for both ART and pre-ART work up | Total minutes per year | Salary ppy (USD) |
|---|---|---|---|---|
| Doctor time in min( Diagnosis and consultation) per visit | 10 | 10 | 100 | 4.29 |
| Nurse time(for Adherence counseling) per visit | 20 | 12 | 240 | 4.94 |
| Lab technician | 86 | 5 | 430 | 8.85 |
| Pharmacist/pharmacy technician time per visit | 10 | 6 | 60 | 1.64 |
| | | | Total | **19.72** |

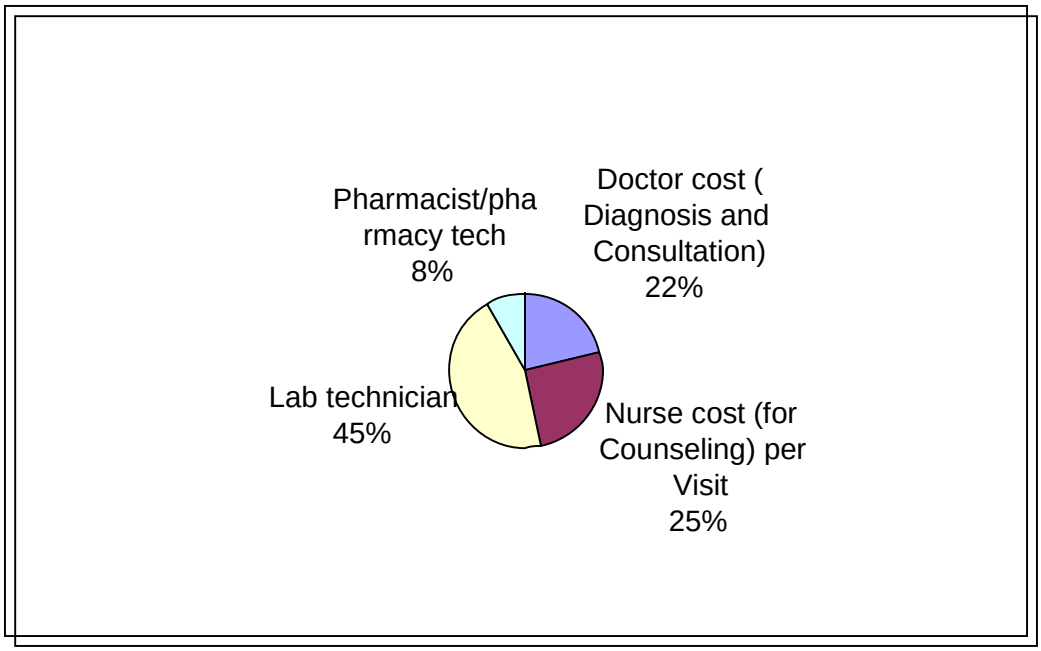


Fig 3: Total direct health professional cost.

The pie diagram compares Lab technician time take 45% of the labor cost contribution to ART with nurse time coming second. Physician time and pharmacy professional time take third and fourth place respectively.

### 5.4 ART Related Overhead Cost

ART related over head is estimated the ART services percentage when compared to other clients which represent around 20% of the total hospital clients.

The largest over head cost goes to data a clerk which is due to high number data processing activities in all of the units. Routine recording and reporting at the clinics, pharmacy and lab for program monitoring and evaluation and intervention as required. Re-supply of commodities to health facilities is done based on consumption reports sent to medical store. Activities like HMIS and DMIS proved to be very important in decision making and program monitoring.

Table 4: ART related overhead cost analysis

| Over head cost | Mean cost per patient par year(USD) |
|---|---|
| Non-direct patient care time for a health professional(Medical director) | .15 |
| Labor for administrative staff | .03 |
| Electricity | .03 |
| Data clerks | 0.96 |
| Security | - |
| Telephone | 0.54 |
| Internet | 0.48 |
| Cleaning supplies | 1 |
| Stationery supplies | 1 |
| HMIS | .36 |
| DMIS | .90 |
| Lab log books | .03 |
| Total over head cost per patient per year | **5.48** |

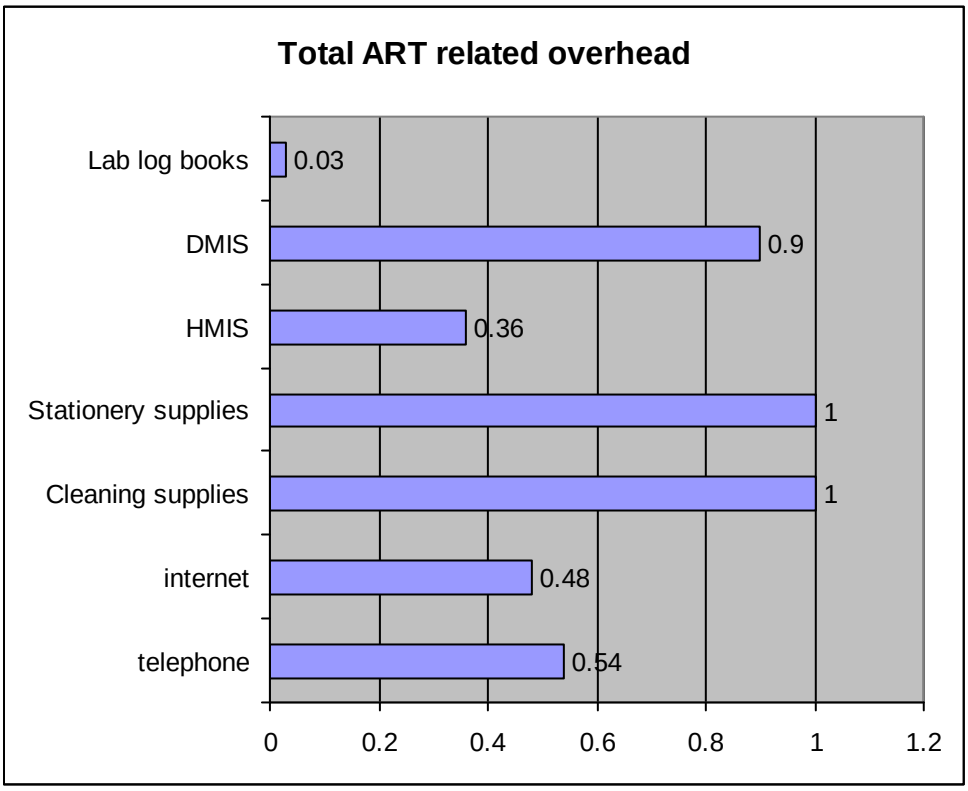


Fig 4: Total ART related overhead cost plotted in a bar graph where Y axis represents areas and X axis represent cost in USD.

**5.5 ART related capital cost**

Given the building is very old and no capital cost allocation available, the economic cost is used assuming what would be the rental fee per square meter of the floor.

The facility a total of 200metersquare is allocated for the clinic, lab and pharmacy. Based on my interview with the owners of shop around it costs up to 50 birr per square meter in the locality to get a space for business. The total area used was converted in to cost using the market value of 50birr/sqm and divided to the total number of clients served at the facility that base year. At the end of August, 2006 there were 3479 ART clients on ART

as stated on the monthly ART uptake report of August, 2006 [17].The average cost of the different chemistry, hematology and CD4 machine is USD 2000 with assumption of 5 years live span. Most other equipments have less than one year shelf life so excluded from the capital cost.

**Table 5: ART related capital cost analysis**

| | Cost in USD |
|---|---|
| Building/as economic cost of per square meter | 0.87 |
| ART clinic computers and furniture | 0.1 |
| Lab equipments(cd4,hematology,chemistry machines | 2.06 |
| Transportation and storage of medication and equipment | 0.04 |
| Total | 3.03 |

For all the exchange rates 1usd=9.1ETB

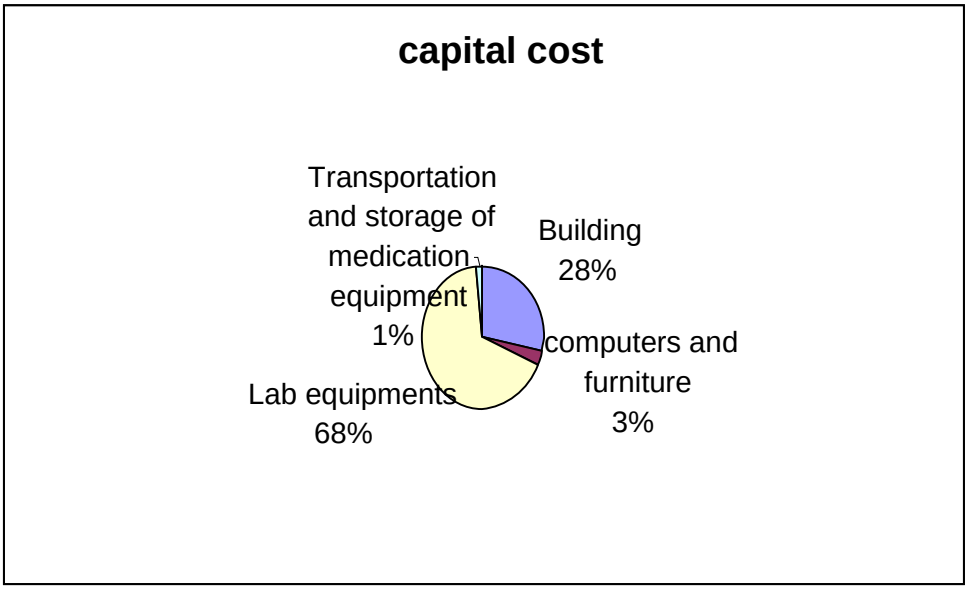


Fig 4: ART related capital cost.

With aging building and low economic cost assumption the lab machines take the major capital cost at Zewditu Hospital.

### 5.6 Over all Cost Finding

The mean total cost of out patient treatment was USD 342.66 Table 6 presents this value PPY. This includes 314.43 as direct treatment cost, USD 19.72 direct health professional cost, USD 5.48 over head cost and USD 3.03 for capital cost.

Table 1 shows the mean direct cost per patient per year which is USD 210.82 for ARV the largest when compared with the group and the remaining health professional, indirect ,overhead and capital cost, USD 90.94 for labs and related diagnostics, USD 12.67 for other medication including OI drugs and TB drugs.

PPY cost of USD 19.72 was spent as a direct health professional cost which is directly related to personnel spending 100 % of their time at the ART clinic, ART pharmacy and ART lab units.

The over head cost was 5.48 the largest of which is the cost for data managers Table 3.

The capital cost PPY was USD 3.03 the largest of which is the depreciation cost for the ART lab equipments as seen in table 4.

**Table 6: Total Annual cost of ART at Zewditu Hospital PPY**

| | **Overall cost in USD** | **Percent (%)** |
|---|---|---|
| Direct treatment cost PPY | 314.43 | 91.7 |
| Direct health professional labor cost PPY | 19.72 | 5.7 |
| Total overhead PPY | 5.48 | 1.6 |

| | | |
|---|---|---|
| ART related capital cost PPY | 3.03 | 1 |
| | **342.66** | **100%** |

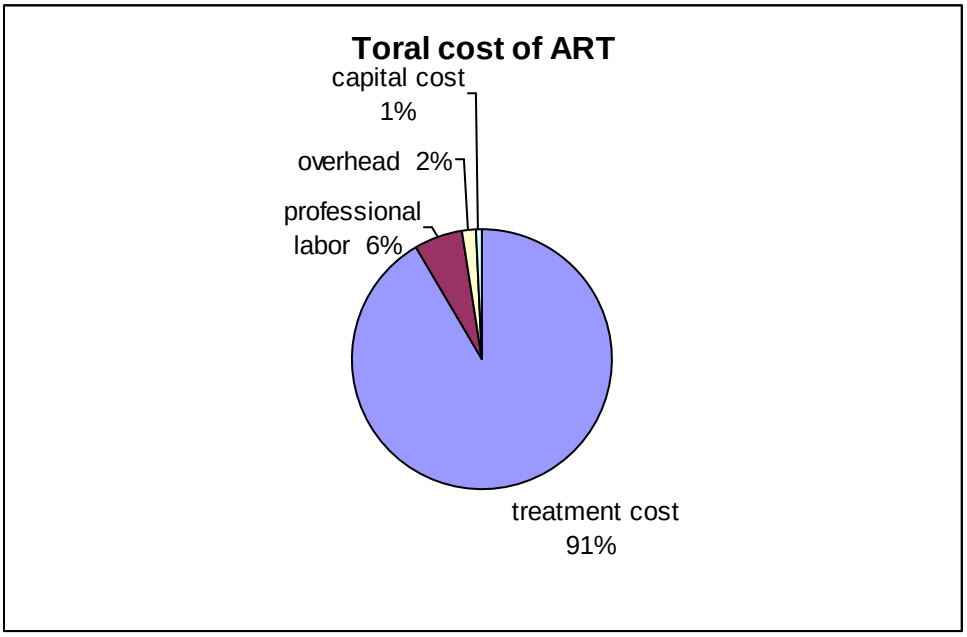


Fig 5: Total PPY cost of ART at Zewditu Hospital,

As can be seen from this pie diagram the largest cost goes to direct treatment or service utilization costs at the ART clinic

## 6. Discussion

This study determined direct medical costs, overhead, capital and direct health professional cost of providing ART in a public sector health facility for the first year.The major services driving the cost of ART in Zewditu hospital are direct health care services of ARV drugs,lab monitoring and OI drugs comprising of 91% of the total cost.

In Zewditu Hospital patients take ARVs for an average cost of USD 210.82 for a three drug combination per year. This means ARV can be made available for less than a dollar per day in Ethiopia. With the decreasing cost of ARV drugs and fixed dose combinations made available recently (31) still ARV cost consumed up to two third of the PPY cost of ART in Zewditu Hospital.

Lab tests for monitoring response and toxicity detection cost an average cost or USD91 which is around a quarter of the total cost of ART in Zewditu Hospital by consuming USD91.

OI drugs and other drugs dispensed in relation to HIV take around USD12,cotrimoxazole is take almost 60% of the total dollar spent on OI drugs which is due to the fact that all patients will take cotrimoxazole as a prophylaxis daily for the first year of treatment.

The unit PPY ART cost USD 342.66 of this study obtained for out patient ART cost was greater than that of reported by the Arbaminch Hospital (16) but less than that of South Africa (18) and Haiti (19).With the gradual reduction in ARV price now made available for less than USD 100 PPY for D4T based regimens (20).When the lab monitoring cost is compared with that of the Arbaminch Hospital Study (10) and Haiti study (13) our study has a higher CD4 test utilization rate which could result from a recent support by

PEPFAR on procurement of lab and other diagnostic supplies. When compared with the Haiti Study (13) USD 355 for ARV, lab and imaging USD 130, direct health professional labor USD 51, non ARV medications USD 39 is greater than our estimation which could result due to less associated direct cost and the use of generic supplies.

Our mean labor cost for PPY out patient visit of USD 19.72 table 3 was greater than that of Haiti (19).This was mainly due to the higher number of out patient visits observed at ZH with more nurse and lab encounter than the Haiti team. More CD4 tests were done 2.09 PPY than 1.3(19) in Haiti which could contribute for the higher number of hours spent on ART client bay a lab technicians.

This facility runs with far less number of health professionals than this model and other studies indicated (12-15).With high client burden on treatment and chronic care in the facility additional staffs could hasten ART scale up.

Several studies have been done to address the cost of ART (10-21) using different scenario and assumption. In a recent study done by Demissie et al, it is reported that an annual cost of USD 235 is required to provide ART at an out patient setting (17).Data from sub-Saharan Africa by Bertozi et al (18) reported a per person year cost of US538.a study from South Africa (18) stated that the cost of ART decreased compared with a non-ART condition. A recent report from Haiti suggested that ART costs approximately USD 1000 PPY of which 36% goes to the cost of ARV (20).The cost per year of healthy life gained would be only 8776 to USD 13902 for triple combination therapy if they worked, even before cost saving due to prevented income losses and avoided medical cost are considered (11).

From a Boston university study in 2006 (21), 17 eligible cost estimates were found. Of these, 10 were from South Africa. The cost per patient per year ranged from $396 to

$2,761. It averaged approximately $850/patient/year in countries outside South Africa and $1,700/patient/year in South Africa. The most recent estimates for South Africa averaged $1,200/patient/year. Specific cost items included in the average cost per patient per year varied, making comparison across studies problematic. All estimates included the cost of antiretroviral drugs and laboratory tests, but many excluded the cost of inpatient care, treatment of opportunistic infections, and/or clinic infrastructure. Antiretroviral drugs comprised an average of one third of the cost of treatment in South Africa and one half to three quarters of the cost in other countries which is in favor of this study finding in Zewditu Hospital. This finding is out side the range of this study because of a rapid decrease of cost of ARV and related services (22).

In a WHO sponsored study (21), Depending on the treatment regimen used, the price of first-line medication has decreased between 37% and 53% in the past two years. This has contributed significantly to wider availability of treatment, but prices remain unacceptably high in some countries, especially for second-line regimens. In 2005, the average price paid for first-line treatment (prequalified by WHO) in low-income countries ranged from US$ 148 per person per year for the fixed-dose combination of stavudine + lamivudine + nevirapine (the most widely used combination) to US$ 549 for the fixed-dose combination zidovudine + lamivudine plus a single dose of efavirenz . The average price of these two combinations was US$ 268 per person per year in 2005.The fall in drug prices between 2003 and 2005 has been fuelled by the ongoing scale-up of treatment programmes as well as by increased competition among a growing number of products prequalified by WHO. The price decrease is also attributable to negotiations between the William J. Clinton Foundation and major generic manufacturers (17).

From the direct treatment cost ARV takes the lions share with 66% percent and when the direct cost is compared with the remaining cost centers it took 91% percent of the total expenditure (Table 6). The cost of ARV of this study was less than that of the Haiti (19) and South Africa (18). Most studies show that the major cost goes to direct cost of ARV,lab monitoring ,OI drugs and direct health personnel costs (10, 11, 12, 13,14, and 15).

On the other hand, ART has had a major impact on the health of people living with HIV/AIDS. However it does mean that large numbers of people now need to have regular checks at hospitals clinics for monitoring of drug-side effects and disease progression, for repeat drug prescriptions, and other care (26).

The major hurdle for health services in sustaining the provision of long-term care for people living with HIV, and scaling-up treatment services further, is the severe shortage of doctors and nurses. This has reached a crises point in most African countries. Maintaining regular clinic follow-up is also a major challenge for patients on ART because of the high cost and limited availability of transport. Research in Jinja district, Uganda, shows that the average cost of accessing treatment (mostly transport to the clinic) is around 13-20% of patients' monthly income. In most countries, ART services are delivered through hospitals which serve large populations and are located in urban areas. This has the advantage that patients can be treated by specialist clinical staff. However, there are considerable draw-backs. Given the scale of the need for ART and the severe shortage of clinical staff, especially doctors, demand for these services far exceeds the capacity of hospitals. From the patients' perspective, getting transport from rural and semi-urban areas to a hospital is often difficult and prohibitively expensive, meaning many are unable to access ART. In addition, centralized clinics are often overcrowded

and waiting times are long. To what extent HIV management needs to be done at clinic by doctors and nurses is not clear. WHO recommend decentralized service delivery and use of lower level health-care workers to increase access to ART, but the evidence-base for this strategy is limited (20).

In summary ART cost USD342.66 in Zewditu Hospital for the first year of treatment with three drug combination ARV dugs taking 61% of the total cost.Further analysis showed that to treat 1000 cleints in Zewditu Hospital  a human resource of 1 physicain,1pharmacist,2.5nurses and 4.5 lab technicians.

**6.2 Strength of the Study**

1. It depicts a PPY cost analysis of ART from the health facility perspective which indicates the total cost of ART. As the contribution from user fee is minimal or non-existent.

2. Costs were compared with each other so that they enable program managers to now the most expensive components and helps in priority setting.
3. The study was conducted in a public health facility in the heart of Addis where there is an optimum ART care by Ethiopian standard and the facility has similarity with most of the public sector setting in Ethiopia.

### 6.3 Limitations

1. Time and resource constraint limited this study to a public sector health facility as treatment costs and human resource demands will likely vary from facility to facility.
2. Because of time constraint only few observations were made for the time motion study of ART clinic, lab and pharmacy staffs.
3. An availability of capital cost forced us to use economic cost of buildings in the vicinity.
4. Including pediatric and lost follow-up clients would have added some other dimension to this study.

## 7. Conclusion and Recommendations

The analysis indicates that the highest cost is associated with direct treatment cost. High costs are associated with antiretroviral drugs followed by treatment monitoring lab tests. In a public sector health facility on average USD 340.64 at 95% CI must be spent at an out patient level to keep a single patient for the first year on treatment.

Further calculations revealed a total of 1 physician, 2.5 nurses, 4.5 lab technicians and 1 pharmacist are needed to treat 1000 ART clients in a public health facility.

This could help as a tool for estimating resource requirement to provide ART at public health facility in Ethiopia. Further cost studies must be done specially in the private sector and pediatric patients to consolidate this finding. The implication of this finding goes beyond Zewditu Hospital as the facility is similar to most other in the country.

As there is a huge demand for ART and only half of the universal access target is reached by this time, cost analysis is a good tool to understand the resource requirement and subsequent service expansion (10-22).

Our study of cost estimates if supported with studies in the private sector could help in the implementation of ART in Ethiopia if augmented with further studies in private sector and training hospitals with a specialized care.

This study can help as entry point for further cost effectiveness analysis of ART program in Ethiopia.

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## 9. Appendix

Annex 1

Consent form

Dear Respondent

My Name is Shimelis Endailalu. I am a master of public health student at Addis Continental Institute of Public health and University of Gondar. I have permission from the Hospital to interview you and get information and estimate the mean annual cost of ART at Zewditu Hospital. Any information you give me is confidential and It is not going to be shared to no one else except the research team without mentioning any thing about you. All your responses are very useful for the study and any time you don't want to respond, your right not to is totally maintained

I thank you in advance for taking a time with me.

Do you agree to interview? Yes___ No ____

Name of Interviewer: _____

Date of interview: _____

Code: _____

Time started: _____

Time ended: _____

Annex 2: Data Sheet For the costing of HIV/AIDS at Zewditu Hospital

1. Folder Number ☐ (Patient will remain anonymous)
2. Date ……. /……/……..
3. Patient on treatment ☐ ransferred ☐ st to follow up ☐
4. Demographic information Sex ☐ age. ☐ Weight ☐

5. Department : Pads ☐ Medicine ☐ Gynecology ☐ Obstetric ☐ Surged ☐
6. In-patient day ☐ (e.g. Day 1,Day 2, etc) ☐
7. Ordinary Hospital bed ☐/ ICU /High care unit ☐
8. HIV/ADIS related disease diagnosis and complications

| Diagnosis | |
|---|---|
| a) | c) |
| b) | d) |

9. Describe the patient according to W.H.O Clinical Staging Criteria 1 ☐ 2 ☐
   3 ☐ 4 ☐
10. Procedures done only in relation to HIV/ADIS illness or complication (please tick -)

    Pleural tap ☐ Neb Mask ☐ IV drip line ☐ EC ☐

    Lumber Puncture ☐ Biopsy ☐ Oxygen (FMO2 ☐

    Bronchoscopy ☐ Sigmidoscopy ☐ Naso-gastic tube ICD inserted ☐

Other ☐ Specify: ……..

11. Consumable used only in relation to HIV/AIDS illness or compilation(the total amount used daily for each item) *Please Check consumable list*

a)……

d)……

b)……

e)……

c)……

f)……

12. Laboratory service, and blood product used in relation to HIV/ADIS illness or complication. Please check laboratory service.

a)……

e)……

b)……

f)……

c)……

g)……

d)……

h)……

13. Radiology

Only in relation to HIV/ADIS illness or complication

| **Sonar** | **CT** | **X-Ray** | **Nuclear Med** |
|---|---|---|---|

Specify:

…….

14. Theater: Only in relation to HIV/ADIS illness or complication

    Yes ☐ No ☐

    Description: ……☐Hours:

15. Doctor : Note down approximately how much time was spend with the patient examining ,doing procedure and other tasks: ☐

    Less than 15 min ☐ 15 min ☐ 30 min ☐

    45 min ☐ 60 min☐ more than 60 min ☐

16. Received counseling from social worker/nurse: only in relation to HIV/ADIS illness or complication

    Yes ☐ No ☐

17. Received Physiotherapy only in relation to HIV/ADIS illness or complication

    Yes ☐ No ☐

18. Miscellaneous : Only in relation to HIV/ADIS illness or complication

    Specify: …….

19. Any Prophylactic treatment given? Yes ☐ No ☐

    Example: Co-trimoxazole or INH Specify: ……

20. Is the Patient on TB treatment? Yes ☐ No ☐ (if yes Please specify under 22)

21. Is the patient on Anti-retroviral treatment? Yes ☐ o ☐ yes Please specify under 22)

22. Medication:Only in relation to HIV/ADIS illness or complications

Please tick where appropriate

a) ☐ Discharge medication, please note total amount as dispensed by our Pharmacy. Applicable only at last day of stay.

b) ☐ In patient Medication .Please note total amount per day as dispensed by your Pharmacy.

| *Name of Medication* | *Dosage* | *PO/IV/IMI* | *Total amount* |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

23. Is patient referred to higher level for illness related to HIV/AIDS? Yes ☐ ☐

Specify the reason if the answer is yes? ----------

Annex 3: Antiretroviral drugs costing tool

| Sr. | Product | Unit |
|---|---|---|

| No. | | price |
|---|---|---|
| 1 | Abacavir 20mg/ml, 240ml | |
| 2 | Abacavir 300mg, 60 tabs | |
| 3 | Didanosine 100mg, 60 tabs | |
| 4 | Didanosine 250mg, 30caps | |
| 5 | Didanosine 25mg, 60 tabs | |
| 6 | Didanosine 2g powder | |
| 7 | Didanosine 400mg,30 caps | |
| 8 | Efavirenz 200mg, 90 caps | |
| 9 | Efavirenz 30mg/ml, 180ml | |
| 10 | Efavirenz 50mg, 30 caps | |
| 11 | Efavirenz 600mg, 30 tabs | |
| 12 | Indinavir 400mg, 180 tabs | |
| 13 | Lamivudine 10mg/ml,240ml | |
| 14 | Lamivudine 150mg, 60 tabs | |
| 15 | Lopinavir/r, 166mg, 180 caps | |
| 16 | Lopinavir/r, 80/20mg/ml, 300ml | |
| 17 | Lopinavir/ritonavir,(200+50) Tablet of 120 | |
| 18 | Nelfinavir 250mg, 270 caps | |
| 19 | Nevirapine 10mg/ml, 240 ml | |
| 20 | Nevirapine 200mg,60 tabs | |
| 21 | Ritonavir 100mg capsule of 336 capsules | |

| | | |
|---|---|---|
| 22 | Stavudine 12mg/Lamivudine 60mg of 60 | |
| 23 | Stavudine 12mg/Lamivudine 60mg/Nevirapine 100mg of 60 | |
| 24 | Stavudine 15mg, 60 caps | |
| 25 | Stavudine 1mg/ml, 200ml | |
| 26 | Stavudine 20mg, 60 caps | |
| 27 | Stavudine 30mg, 60 caps | |
| 28 | Stavudine 40mg,60 caps | |
| 29 | Stavudine 30mg/Lamivudine 150mg of 60 | |
| 30 | Stavudine 30mg/Lamivudine 150mg/Nevirapine 200mg of 60 | |
| 31 | Stavudine 6mg/Lamivudine 30mg of 60 | |
| 32 | Stavudine 6mg/Lamivudine 30mg/Nevirapine 50mg of 60 | |
| 33 | Tenofovir 300mg, 30 tabs | |
| 34 | Zidovudine 100mg, 100 caps | |
| 35 | Zidovudine 10mg/ml, 100ml | |
| 36 | Zidovudine 10mg/ml, 240ml | |
| 37 | Zidovudine 300mg, 60 tabs | |
| 38 | Zidovudine 300mg/Lamivudine 150mg/Nevirapine 200mg of 60 | |
| 39 | Zidovudine/Lamivudine 450mg, 60 tabs | |

Annex 4: ART lab monitoring commodities and rapid test kits costing tool

| Item Description | Unit price |
|---|---|
| | |

| | | |
|---|---|---|
| | | |
| HIV rapid tests | | |
| Screening | *Determine* | |
| Confirmatory | *Capillus* | |
| Tie-Breaker | *Unigold* | |
| CD4 reagents | | |
| CD4 reagent kits (Double tube) | | |
| CD4 control kits | | |
| FACSflow | | |
| FACSclean | | |

| | |
|---|---|
| | |
| FACSrinse | |
| Thermal paper for FACS Count | |
| Tru Count Tubes w/ monoclonal | |
| Facs Lysing | |
| FACS Calibrite 3 -25 tests | |
| Chemistry | |
| ALP | |
| Alpha-amylase | |
| Bilirubin - direct | |
| Bilirubin - total | |
| BUN | |

| | |
|---|---|
| | |
| Cholesterol | |
| Creatinine | |
| Glucose | |
| GOT (AST) | |
| GPT (ALT) | |
| Triglycerides | |
| Chemistry multi-calibrator | |
| Control, normal | |
| Control, pathological | |
| Haematology | |
| Cell-Dyn detergent solution | |

| | |
|---|---|
| | |
| Cell-Dyn isotonic diluent | |
| CN-free HGB/WIC (diff) lyse | |
| Cell-Dyn enzymatic clean | |
| Cell-Dyn calibrator | |
| Cell-Dyn trilevel control | |
| Consumables | |
| Glove, latex disposable, large | |
| Glove, latex disposable, medium | |
| Glove, latex disposable, small | |
| Pasteur pipette, 3ml | |
| Vacutainer tube, EDTA 5 mL | |

| | |
|---|---|
| (purple top) | |
| Vacutainer needle, 21 G | |
| Vacutainer tubes, plain/red-top, 10ml | |

Annex 5:

Other Consumable supplies

| Item Description | Unit price |
|---|---|
| | |

| | |
|---|---|
| | |
| Consumable items | |
| Blood Lancent of 100/pack | |
| EDTA capillary Tube, 50 Micro liters,<br>case of 100 | |
| Glove, latex disposable large, powdered, 100pcs | |
| Glove, latex disposable medium, powdered, 100pcs | |
| Glove, latex disposable small, powdered, 100pcs | |
| BD Vacutainer needle 21 G, 1000 | |
| BD Vacutainerone use holders, 1000pcs | |
| BD Vacutainer PLK2 E, or EDTA 5 ml, 1000pcs | |

| | |
|---|---|
| BD Vacutainer tubes, Cat plus or plain/red-top,<br>10ml, 1000 pcs | |
| Pasteur pipette, non-sterile, 3ml, 500pcs | |
| Biohazard bag, 610x760 mm, 100pcs | |
| Cryobox for 1.8 ml tubes, 10X10 autoclavable, 1pcs | |
| Cryogenic vials 1.8 ml size, 1800pcs | |
| | |
| Lancets, 2000pkg | |
| Contact purple lancet of 2000pcs | |
| Pipette tips 1000 ul, 1000pcs, non-filtered Blue | |
| Pipette tips 200 ul, 1000pcs, non-filtered, Yellow | |
| Sharps container, 22.5 liter, 5 pk | |
| Sodium hypcholorite, 1 liter | |
| Test tube racks of 30 holes for 10ml plain tubes | |

| | |
|---|---|
| | |
| Tourniquet, 100 Pkg | |
| Disposable syringes , 21G needle, 10ml size, 500pcs | |
| Disposable syringes , 21G needle, 2ml size, 500pcs | |
| Disposable syringes , 21G needle, 5ml size, 500pcs | |
| Face masks, sterilizable, 50pcs | |
| White apron, reusable plastic, medium 100 pack | |
| White apron, reusable plastic, small 100 pack | |
| Incenirator plastic bin | |
| Rack wire poxy grid half size | |
| Tests various | |
| RPR syphilis test kits | |

| | |
|---|---|
| Pregnancy test kits - dipstick | |
| Cryptococcal latex Ag test kits | |

Annex 6:Human Resource Questionnaire

Hello, My Name is Shimelis Endailalu. I am collecting Data for the costing of antiretroviral therapy at Zewditu Hospital and here want to collect information about your ART clinic's human resource capacity. I would like to ask you few questions about your staff as well as some questions pertaining to HIV/AIDS services. Please note that the

information required was that of 2006. All information collected will be kept confidential and will only be used for the intended purpose.

1. Name of the Health Facility_____
2. Name of the respondent _____
3. Date of interview _____

| Staff type | Total number | Current monthly salary |
|---|---|---|
| Doctors | | |
| Nurses | | |
| Lab technicians | | |
| Pharmacists | | |
| Counselors | | |
| Social Workers | | |
| Data clerks | | |

Thank you for participating in the survey!

**Annex7: Work Plan**

| **Thesis work plan and Time line** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| **Sr.** | **Technical Objective** | **Activity** | **Time line** | | | | | |

| No | | | Jan | Feb | March | April | May | June |
|---|---|---|---|---|---|---|---|---|
| 1 | Detailed description of cost component of delivering ART in the public sector health facility in Addis Ababa | 1. Develop and agree on the thesis proposal for a partial fulfillment of the requirements for the degree of Master of Public Health | | | | | | |
| | | 2. Refine data collection tools and start the Data collection at Zewditu Hospital | | | | | | |
| | | 3. Data entry and analysis | | | | | | |
| | | 4.Data compilation and Report writing | | | | | | |
| | | 5. Submission of Draft report | | | | | | |
| | | 6. Finalization and Defense of thesis out comes | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

**Annex 8: General cost information for ARVs**

**Naïve Patients**

| | Regimen | Percentage | Cost PPPM | Cost PPPY |
|---|---|---|---|---|
| 1 | **AZT/3TC/NVP** | **40.00%** | **$20.50** | **$246.00** |
| 2 | **AZT/3TC/EFV** | **30.00%** | **$21.92** | **$263.04** |
| 3 | **TDF/3TC/EFV** | **24.00%** | **$32.46** | **$389.52** |
| 4 | **TDF/3TC/NVP** | **5.00%** | **$23.44** | **$281.28** |
| 5 | **ABC/3TC/AZT** | **0.50%** | **$37.03** | **$444.36** |
| 6 | **ABC/3TC/NVP** | **0.50%** | **$33.97** | **$407.64** |
| | **Weighted Average cost per patient per year** | | **$289.08** | |

**For Experienced patients**

| | Regimen | Percentage | Cost PPPM | Cost PPPY |
|---|---|---|---|---|
| 1 | **d4T/3TC/NVP** | **43.35%** | $7.40 | $88.80 |
| 2 | **d4T/3TC/EFV** | **20.75%** | $16.42 | $197.04 |
| 3 | **AZT/3TC/NVP** | **16.45%** | $20.50 | $246.00 |
| 4 | **AZT/3TC/EFV** | **12.67%** | $21.92 | $263.04 |
| 5 | **TDF/3TC/EFV** | **4.00%** | $32.46 | $389.52 |
| 6 | **TDF/3TC/NVP** | **1.73%** | $23.44 | $281.28 |
| 7 | **ABC/3TC/EFV** | **0.50%** | $42.99 | $515.88 |
| 8 | **ABC/3TC/NVP** | **0.50%** | $33.97 | $407.64 |
| | **Weighted Average cost per patient per year** | | **$178.32** | |

| | Regimen | Percentage | Cost PPPM | Cost PPPY |
|---|---|---|---|---|
| 1 | **AZT/3TC/NVP** | **17.28%** | **$14.56** | $ 174.72 |
| 2 | **AZT/3TC/EFV** | **9.72%** | **$23.57** | $ 282.84 |
| 3 | **TDF/3TC/EFV** | **1.80%** | **$35.48** | $ 425.76 |
| 4 | **TDF/3TC/NVP** | **3.20%** | **$25.74** | $ 308.88 |
| 5 | **ABC/3TC/EFV** | **0.36%** | **$47.28** | $ 567.36 |
| 6 | **ABC/3TC/NVP** | **0.64%** | **$37.54** | $ 450.48 |
| 7 | **d4T/3TC/NVP** | **42.88%** | **$8.40** | $ 100.80 |
| 8 | **d4T/3TC/EFV** | **24.12%** | **$17.95** | $ 215.40 |
| | **Weighted Average cost per patient per year** | | **$242.88** | |

**Note: PPPY=Per Patient Per Year**

**Note: PPPM=Per Patient Per Month**

Over All Cost of Antiretroviral drugs from the National quantification, from 2009-2014

| Product | Packaging | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Abacavir 300MG/tab | 60 | 24,118 | 34,486 | 40,068 | 42,858 | 44,937 | 45,083 | **186,467** |
| Efavirenz 600MG/tab | 30 | 1,028,492 | 1,593,526 | 1,897,754 | 2,049,819 | 2,163,097 | 2,194,877 | **8,732,689** |
| Lamivudine 150MG/tab | 60 | 322,222 | 633,250 | 800,715 | 884,420 | 946,775 | 984,595 | **3,587,382** |
| Lamivudine-Stavudine 150+30MG/tab | 60 | 357,860 | 357,860 | 357,860 | 357,860 | 357,860 | 328,038 | **1,789,299** |
| Lamivudine-Stavudine-Nevirapine 150+30+200MG/tab | 60 | 747,625 | 747,625 | 747,625 | 747,625 | 747,625 | 685,323 | **3,738,125** |
| Lamivudine-Zidovudine 150+300MG/tab | 60 | 424,665 | 735,693 | 903,158 | 986,863 | 1,049,218 | 1,078,501 | **4,099,596** |
| Lamivudine-Zidovudine-Nevirapine 150+300+200MG/cotab | 60 | 558,574 | 973,277 | 1,196,564 | 1,308,172 | 1,391,311 | 1,430,993 | **5,427,898** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nevirapine 200MG/tab | 60 | 84,872 | 144,629 | 176,804 | 192,887 | 204,867 | 210,220 | **804,058** |
| Tenofovir disoproxil fumarate 300MG/tab | 30 | 298,104 | 598,764 | 760,647 | 841,562 | 901,839 | 939,513 | **3,400,917** |

**Cost**

| **Product** | **Pack Price** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **TOTAL** |
|---|---|---|---|---|---|---|---|---|
| Abacavir 300MG/tab | $32.21 | $776,849 | $1,110,789 | $1,290,592 | $1,380,464 | $1,447,413 | $1,452,113 | **$7,458,220** |
| Efavirenz 600MG/tab | $14.53 | $14,945,433 | $23,156,166 | $27,577,024 | $29,786,745 | $31,432,830 | $31,894,632 | **$158,792,830** |
| Lamivudine 150MG/tab | $3.56 | $1,146,079 | $2,252,343 | $2,847,982 | $3,145,706 | $3,367,490 | $3,502,008 | **$16,261,608** |
| Lamivudine-Stavudine 150+30MG/tab | $4.68 | $1,674,784 | $1,674,784 | $1,674,784 | $1,674,784 | $1,674,784 | $1,535,218 | **$9,909,136** |
| Lamivudine-Stavudine-Nevirapine | $8.66 | $6,472,937 | $6,472,937 | $6,472,937 | $6,472,937 | $6,472,937 | $5,933,526 | **$38,298,212** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 150+30+200MG/tab | | | | | | | | |
| Lamivudine-Zidovudine 150+300MG/tab | $11.12 | $4,720,149 | $8,177,223 | $10,038,596 | $10,968,984 | $11,662,057 | $11,987,540 | **$57,554,548** |
| Lamivudine-Zidovudine-Nevirapine 150+300+200MG/cotab | $23.99 | $13,397,391 | $23,344,060 | $28,699,589 | $31,376,495 | $33,370,599 | $34,322,359 | **$164,510,495** |
| Nevirapine 200MG/tab | $3.98 | $337,619 | $575,335 | $703,327 | $767,303 | $814,960 | $836,253 | **$4,034,798** |
| Tenofovir disoproxil fumarate 300MG/tab | $19.89 | $5,929,289 | $11,909,421 | $15,129,270 | $16,738,678 | $17,937,572 | $18,686,912 | **$86,331,142** |

**Detailed Adult Second Line ARV Requirements by Pack and by Value**

| **Product** | **Packaging** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **TOTAL** |
|---|---|---|---|---|---|---|---|---|
| Nevirapine 200MG/tab | 60 | 223 | 1,244 | 4,334 | 8,923 | 14,762 | 21,598 | **51,084** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Zidovudine 300mg/ tab | 60 | 11,901 | 29,653 | 68,712 | 117,224 | 170,561 | 226,183 | **624,234** |
| Lamivudine 150MG/tab | 60 | 20,285 | 68,449 | 131,906 | 191,009 | 244,263 | 291,882 | **947,793** |
| Efavirenz 600MG/tab | 30 | 273 | 1,546 | 5,433 | 11,307 | 18,908 | 27,953 | **65,419** |
| Lamivudine-Stavudine 150+30MG/tab | 60 | 775 | 744 | 616 | 510 | 423 | 350 | **3,418** |
| Didanosine 250mg/cap | 60 | 24,712 | 69,267 | 131,681 | 194,328 | 254,513 | 311,520 | **986,022** |
| Didanosine 400mg/cap | 30 | 6,970 | 19,537 | 37,141 | 54,810 | 71,786 | 87,865 | **278,109** |
| Lopinavir/ritonavir,(200+50)/tab | 120 | 55,425 | 125,176 | 185,759 | 247,405 | 307,113 | 364,047 | **1,284,925** |
| Tenofovir 300mg/tab | 30 | 25,319 | 73,298 | 135,696 | 193,577 | 245,490 | 291,688 | **965,068** |
| Atazanavir/ritonavir,(300+100)/tab | 120 | 0 | 44,929 | 150,088 | 255,412 | 356,542 | 452,357 | **1,259,328** |
| Abacavir 300mg/tabs | 60 | 19,110 | 78,908 | 168,799 | 260,855 | 350,716 | 436,963 | **1,315,350** |

| **Product** | **Pack Price** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **TOTAL** |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nevirapine 200MG/tab | $4.39 | $978 | $5,459 | $19,016 | $39,149 | $64,768 | $94,761 | **$224,132** |
| Zidovudine 300mg/ tab | $9.36 | $111,396 | $277,549 | $643,145 | $1,097,215 | $1,596,449 | $2,117,077 | **$5,842,832** |
| Lamivudine 150MG/tab | $3.51 | $71,199 | $240,256 | $462,989 | $670,441 | $857,363 | $1,024,507 | **$3,326,755** |
| Efavirenz 600MG/tab | $14.63 | $3,986 | $22,612 | $79,453 | $165,364 | $276,528 | $408,818 | **$956,760** |
| Lamivudine-Stavudine 150+30MG/tab | $4.68 | $3,625 | $3,484 | $2,885 | $2,388 | $1,978 | $1,637 | **$15,996** |
| Didanosine 250mg/cap | $14.63 | $361,409 | $1,013,035 | $1,925,841 | $2,842,046 | $3,722,257 | $4,555,978 | **$14,420,567** |
| Didanosine 400mg/cap | $23.40 | $163,098 | $457,165 | $869,097 | $1,282,565 | $1,679,788 | $2,056,031 | **$6,507,743** |
| Lopinavir/ritonavir,(200+50)/tab | $53.62 | $2,971,969 | $6,712,057 | $9,960,615 | $13,266,141 | $16,467,713 | $19,520,593 | **$68,899,089** |
| Tenofovir 300mg/tab | $13.16 | $333,258 | $964,791 | $1,786,099 | $2,547,961 | $3,231,261 | $3,839,340 | **$12,702,710** |
| Atazanavir/ritonavir,(300+100)/tab | $36.07 | $0 | $1,620,637 | $5,413,831 | $9,212,988 | $12,860,879 | $16,316,999 | **$45,425,334** |
| Abacavir 300mg/tabs | $29.25 | $558,975 | $2,308,055 | $4,937,358 | $7,629,999 | $10,258,447 | $12,781,156 | **$38,473,989** |